THE CALTECH ALUMNI

V. The Major Makes a Difference

by JOHN R. WEIR

PREVIOUS ARTICLES in this series have been concerned with comparisons between the Caltech alumni and U. S. college graduates as described by Havemann and West in the book, *They Went to College*. This article will deal with comparisons made within the Caltech group, between those who majored in science and those who majored in engineering. Basically, our scientists and engineers are much alike, but there are some noteworthy differences, even though relatively small.

According to the survey returns, about two-thirds of our alumni are engineers. Alumni were asked to list their undergraduate major and—if they had an advanced degree—their graduate major. Twenty-nine percent of the undergraduate majors were in science, 71 percent in engineering. Thirty-three percent of the graduate majors were in science, and 59 percent in engineering. (These figures are in close agreement with the actual number of degrees granted by the Institute, thus providing further evidence for the validity of the alumni sample. This is true for the sum of all registrations, but today the proportion of scientists to engineers is growing larger. The ratio over the past four years is 40 scientists to 60 engineers out of every 100 undergraduate degrees. The graduate degrees in science have increased to 43 for every 57 engineering degrees.)

There is no significant difference in age between these two groups. A third of both the scientists and the engineers are under 30; 40 percent are between 30 and 39. It should, however, be borne in mind that over 50 percent of our alumni got their degrees since World War II, so both our scientists and engineers are comparatively young.

Work and play

As might be expected, more scientists (32 percent) than engineers (17 percent) report getting "mostly A's." Conversely, more engineers (32 percent) than scientists (20 percent) report getting "mostly C's."

The scientists studied harder while in school, and played less. Fifty-eight percent of the scientists participated in two or more extra-curricular activities; 63 percent of the engineers did so.

The engineers seem the more convinced of the desirability of such preparation. Seventy percent of the engineers who participated in these activities thought they were of value after college; 63 percent of the scientists thought so. Of those who did not participate, 57 percent of the engineers now regret it, and would participate if they had it to do over again. Only 38 percent of the scientists hold this view.

Education's a good thing

Both groups think that their education helped them a lot in their present occupation (scientists—91 percent; engineers—85 percent), although some wish they had majored in another field (scientists—13 percent; engineers—17 percent).

It is interesting that the fields most frequently mentioned by these "dissatisfied" alumni are, for the scientists—some field of engineering; for the engineers—a different branch of engineering. It is a rare Caltech alumnus who wishes he had majored in an entirely different field, such as law, business administration, or the humanities. All the same, some of our alumni have left science and engineering to work in other fields—and this is true for more of the engineers (18 percent) than for the scientists (12 percent).

Attitudes and opinions

As has already been noted (in Part III of this series), Caltech alumni are more "Pro-New Deal," more "Internationalist," and more "Tolerant" in their attitudes and opinions than U. S. college graduates in general.

Within our alumni group, similar consistent differences emerge. The Caltech scientists are more "Pro-New Deal," more "Internationalist," and more "Tolerant" than their engineering brothers. As the chart below shows, the U. S. graduates tend to fall between our engineers and our scientists. Only in the opinions we labeled "Tolerant" is this tendency missing; the Caltech engineers are considerably more "Tolerant" than the U. S. graduates—and the Caltech scientists are even more "Tolerant" than the engineers.

They have to lead

In this highly technical age a person with a specialized education and an advanced technical understanding is constantly faced with the need for communication and leadership skills. The importance of this problem is implied in the very large percentages of our alumni who have other people responsible to them. As the following table shows, practically all of our graduates are apt to have other people responsible to them at some time in their careers.

How Many People Responsible to You?

	Caltech Science Majors	Caltech Engineering Majors	Caltech Total
None	32%	19%	20%
1 through 5	30	26	28
6 through 19	18	24	22
20 through 199	16	24	23
200 and over	4	7	7

The need for training in leadership is clear. Inasmuch as 55 percent of the engineers have more than five people responsible to them, compared with 38 percent of the scientists, the need appears to be greater among the engineers.

ATTITUDES AND OPINIONS

Of Caltech science majors, Caltech engineering majors, and U. S. college graduates

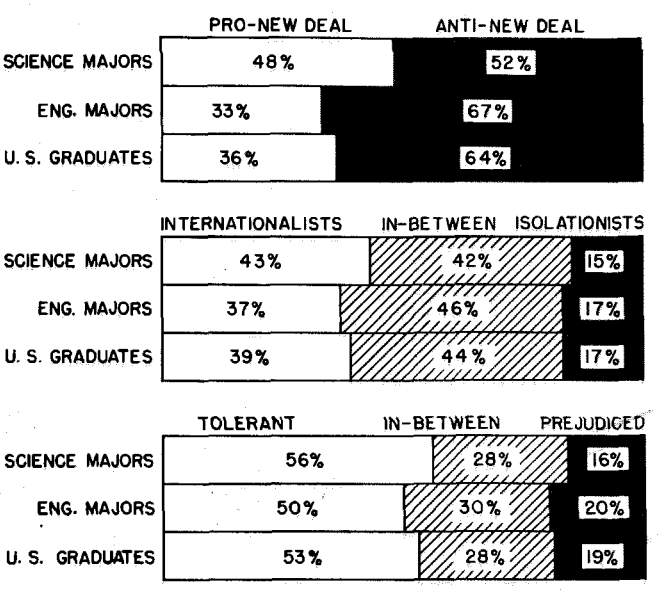
Previous articles have commented on the importance of our highly educated alumni's participating in civic activities, and have presented data demonstrating their apparent failure to do so. As pointed out, this matter of civic affairs participation becomes very significant in terms of income; later in this article there is a discussion of how this significance applies to scientists and engineers.

In the matter of degree of activity, there is a tendency for the engineers to assume more civic responsibility than the scientists, although the difference is not great. Thirty-nine percent of the graduates who majored in engineering participated in five or more civic activities, whereas only 32 percent of the science majors did. These tendencies can be related to employer-employee relationships, and an equal case might be made for the demands made on our graduates to be effective in any group relationship. It is highly improbable that the highly trained scientist or engineer will find many situations in which he can function socially and emotionally isolated from others.

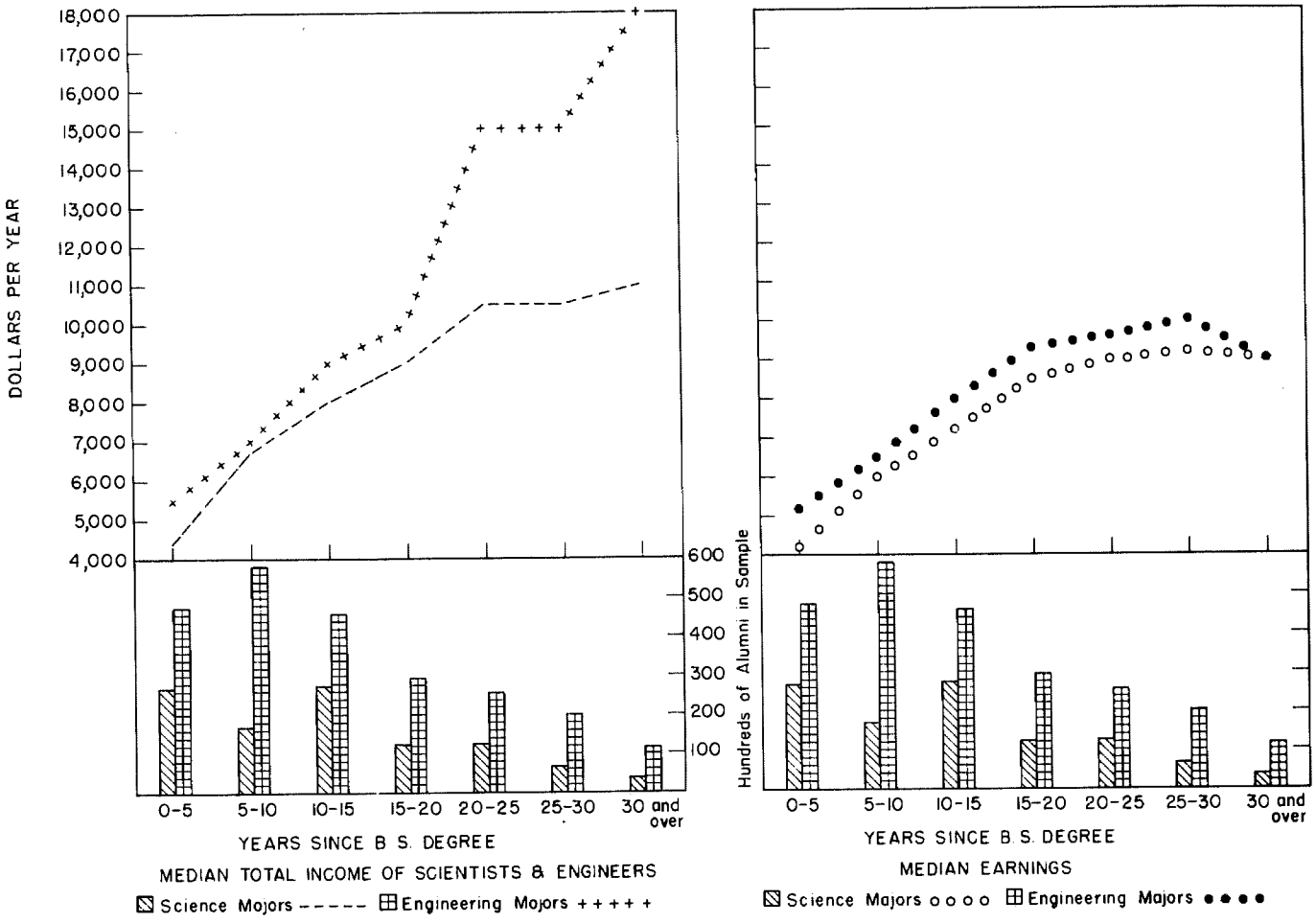
The scientist and the engineer

All of the differences mentioned so far are consistent in their support of the generally held characterization of our scientists and engineers. The scientist is more absorbed in his studies, in scholarly work within his field; he is more preoccupied with objects and things. The engineer places more emphasis on extra-curricular activities, social and civic endeavors, and is more concerned with his relationships with people.

The scientist is somewhat less concerned with social and political affairs, is more inclined to ignore or avoid them, and prefers working with a small number of people. The engineer is more often in close contact with social and political affairs, appears to be more willing to accept and participate in them, and is more likely to have many people responsible to him.



TOTAL INCOME AND MEDIAN EARNINGS
of Caltech Scientists and Engineers



Earnings and income

The chart at the right, above, shows the median *earned* income, by years out of BS degree, for scientists and engineers. It shows an increase with years out of school that is similar for both groups, with the engineers reporting consistently larger earnings at each age.

The average difference between the two groups is $640 per year—a fairly small amount. However, when we add income from consulting activities and from other sources, such as business investments and royalties, the relationship is quite different.

The chart at the left, above, shows the median *total* income for scientists and engineers, by years out of BS. The engineers report increasingly higher total income with advancing age and experience. The average difference between these medians for total income is $2,770 per year. The engineer makes more money than the scientist, but he doesn't do it by working for someone else. He does it by consulting, and by his business and royalty income.

If we characterize the scientist as seeking basic knowledge, and the engineer as applying this knowledge for the increased comfort and convenience of society, then it appears that society considers the latter function the more commendable.

Major field vs. civic activities

In Part IV of this series of articles we considered the relationship between income and participation in civic affairs. It turned out to be an extremely important one. The relationship appears to be equally important when we make comparisons between the earned income medians of our science and engineering majors.

Income and Civic Activities

	Median Earnings		Median Total Income	
	Science Majors	Engineering Majors	Science Majors	Eng. Majors
No civic activities	$5,000	$5,400	$5,000	$6,600
1 to 4 activities	6,000	7,000	6,600	7,400
5 or more activiites	8,000	8,400	9,000	9,600

Consider first the figures for *earned* income. The science major with no civic activities earns $5,000 a year, the engineer $5,400—a difference of only $400. The science major with five or more activities earns $8,000 a year, the engineer $8,400. The difference between scientist and engineer is still only $400—*but* the difference between the men with no civic activities and those with five or more is $3,000. The difference, in other words, is seven and a half times as great as the difference between science and engineering.

The figures for *total* income are similar, suggesting that the increased earnings do not come from extra business contacts made as a result of this civic activity. If that were the case, the differences within the *total* income figures would be much greater.

These results again suggest that the willingness and capacity to participate in civic affairs and to assume civic leadership are accompanied by the capacity to earn increased income. What you *do*, in other words, is more important than what you *know*.

The cost of teaching

Part IV in this series showed the great financial sacrifice that our alumni must accept if they choose to go into the teaching profession. This sacrifice occurs in both engineering and science.

The median income for teaching engineers is $6,400 a year, and for non-teaching engineers it is $7,500—a difference of $1,100 a year. Comparable figures for the scientists are $6,000 and $7,000—a difference of $1,000 a year.

The difference between teaching and non-teaching is twice as great as the difference between scientist and engineer. (This holds for all degrees. If we consider only PhD's, then the scientists lose about $2,000 a year, and the engineers about $3,000 a year if they go into teaching.)

Within the teaching field, the engineer PhD makes $800 a year more than the science PhD. Among the non-teachers, the engineer PhD makes $1,500 a year more than the science PhD.

All these figures point in the same direction. The engineer consistently makes more money than the scientist; the non-teacher consistently makes more money than the teacher—and the latter difference is two to three times as large as the former.

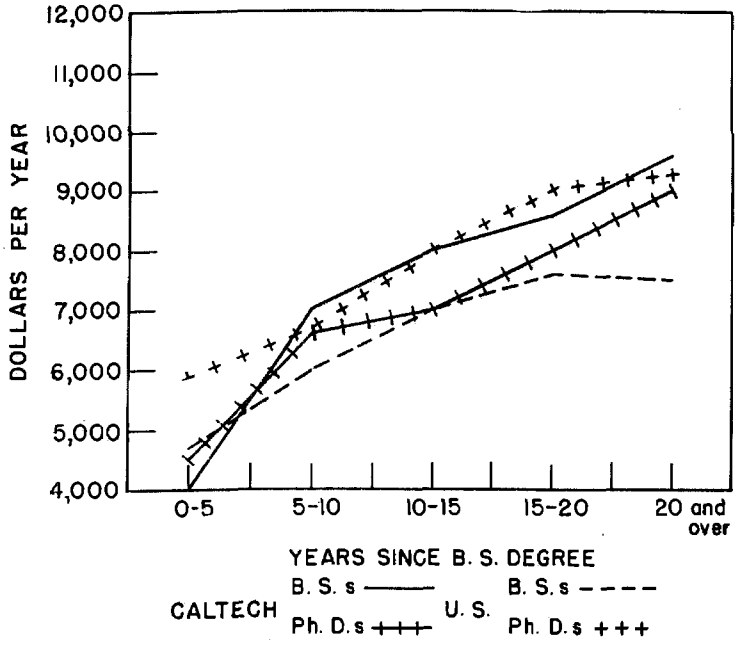
Strictly from the standpoint of earned income, it appears to be of minor importance whether one goes into science or engineering. It is more important whether or not one decides to go into teaching. And it is most important whether or not one is able and willing to participate in civic activities.

Income comparisons with other groups

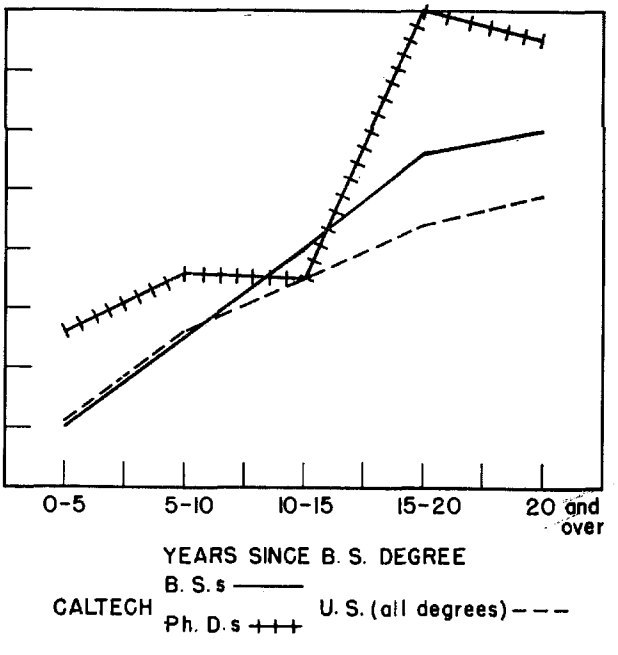
Some data are available for comparing the earnings of Caltech alumni with other groups of scientists and engineers. While these figures are derived from samples which are not exactly identical with our alumni (there

MEDIAN EARNINGS

Caltech Science Majors and U. S. Scientists



Caltech Engineering Majors and U. S. Engineers



are differences in age, occupation, and geographical location), the figures are roughly comparable and sufficient to justify their use here.

Scientists

The following table compares median earnings for scientists in terms of degree and years out of BS. The U. S. figures are obtained from the 1952 National Survey of Professional Scientific Salaries, compiled by the Los Alamos Scientific Laboratory of the University of California.

Yearly Earnings of Scientists

Years Out of BS	BS's		PhD's*	
	CIT	US	CIT	US
0-5	$4,000	$4,700	$5,000	$5,900
5-10	7,000	6,000	7,000	6,700
10-15	8,000	7,000	8,000	8,000
15-20	8,600	7,600	9,000	9,000
Over 20	9,600	7,500	9,600	9,600

* *Does not include teaching PhD's*

Both the Caltech BS and PhD start off making less than the U. S. scientist. However, by ten years out of BS the Caltech man is making as much or more, and maintains this position for the rest of his career.

Engineers

A similar comparison may be made for engineers by using the figures published in the 1952 Professional Engineers Income and Salary Survey.

Yearly Earnings of Engineers

Years Out of BS	Caltech BS's	Caltech PhD's	U.S. BS's & PhD's
0-5	$ 5,000 (264)*	$ 6,600 (11)*	$5,120
5-10	6,500 (253)	7,600 (68)	6,580
10-15	8,000 (203)	7,500 (51)	7,510
15-20	9,600 (153)	12,000 (29)	8,390
20-25	9,500 (136)	9,600 (28)	8,590
25-30	10,000 (150)	15,000 (22)	8,990

* Number of alumni included

Earnings by occupation

These figures can also be broken down according to occupational field—as they are in the table at the bottom of this page.

From these figures it appears that the Caltech engineer may start out somewhat lower than the typical U. S. engineer, but by the end of ten years out of BS he will be making more and will maintain this advantage for the rest of his career.

The trend in these figures is similar for both scientists and engineers. A plausible explanation for this fact might be that the Caltech graduate is trained in the fundamentals of his discipline at the Institute, but must learn the specifics of his profession on the job. It is only after this has been done that he reaches his full earning potential. (This would be least true for the PhD scientists, and they are just the group that deviates from the trend we are considering.) Apparently the Caltech emphasis on fundamentals produces alumni ultimately capable of superior professional competence.

There's a difference

In sum, any difference between the scientist and engineer is probably a reflection of the general trends in twentieth century American culture. Basically, our science and engineering alumni are much alike. Those differences that do occur would appear to be the result of the difference in the social appreciation of contemplation as opposed to application. The more thoughtful scientist is less gregarious and puts less emphasis on material gain; he receives his chief satisfaction from the conviction that he is adding to our basic knowledge of the world. The more outgoing engineer achieves tangible results in the substance of his work, in his contacts with his fellows and his community, and in his material reward.

This is the fifth—and last—of a series of articles discussing the results of the Caltech Alumni Survey.

Yearly Earnings by Occupational Field for Caltech Graduates and U. S. Graduates

Years Out of BS	Administration		Design		Production & Operation		Research & Development	
	CIT	US	CIT	US	CIT	US	CIT	US
0-5	$ 6,000	$ 6,290	$5,200	$5,070	$5,000	$5,120	$5,500	$4,810
5-10	6,600	7,720	6,500	6,500	7,000	7,000	7,500	6,310
10-15	10,000	9,020	7,800	7,110	8,000	7,280	8,500	7,670
15-20	10,000	10,070	8,100	7,640	9,500	8,500	10,000	8,210
20-25	12,000	9,700	8,500	7,800	10,000	8,530	9,500	9,280
25-30	10,900	10,500	8,000	7,990	8,000	8,160	9,200	8,630